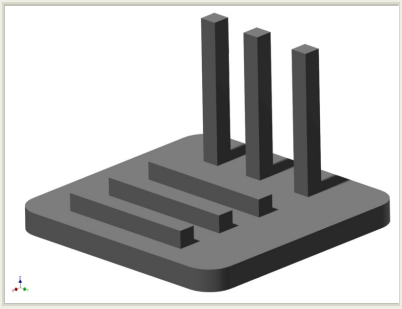
Additively Manufactured, Thermally Stable Telescope Mirror Substrates, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

This proposal is to demonstrate the feasibility of using selective laser melting (SLM) to develop the material composition and the additive manufacturing fabrication process of silicon carbide (SiC) reinforced AlSi10Mg matrix composite (SiC-AMC). ASTS will also demonstrate feasibility that we can customize the coefficient of thermal expansion (CTE) in the substrate material based upon increasing the percent SiC by weight in the AlSi10Mg base substrate. As we are able to select a specific SiC-to-AlSi10Mg ratio that has a CTE closest to an electrolytic nickel-plating CTE, we can reduce the risk of mirror degradation over time due to CTE mismatch-based stresses. For both beryllium and pure silicon carbide as a mirror substrate, the cost factor and risk is quite high from a schedule perspective due to both these materials being very hard and brittle. Therefore, machining anomalies is a much higher risk than other metal mirror substrate materials. Our additive manufacturing development of SiC-AMC could be a game changer in reducing the fabrication cost and schedule risk for a mirror substrate. Another key technical risk to address is the problem of smoothly and consistently applying the metal powderbed over the SLM build plate. We will demonstrate that we can eliminate practically all voids and porosity in the SiC-AMC by teaming with Plasma Processes, Inc. to create a spheroid SiC powder. By this company developing the technique to produce a SiC-AMC powder product, which will allow ASTS to manage the SiC-to-AlSi10Mg ratio, we can assure a uniform SiC distribution within the aluminum base. Through this demonstration, great confidence can be obtained to continue material development in Phase II, establish additional SiC-AMC material properties at higher ratios of SiC, and develop weight efficient mirror substrate designs that meet NASA?s mission requirements.



Additively Manufactured, Thermally Stable Telescope Mirror Substrates, Phase I Briefing Chart Image

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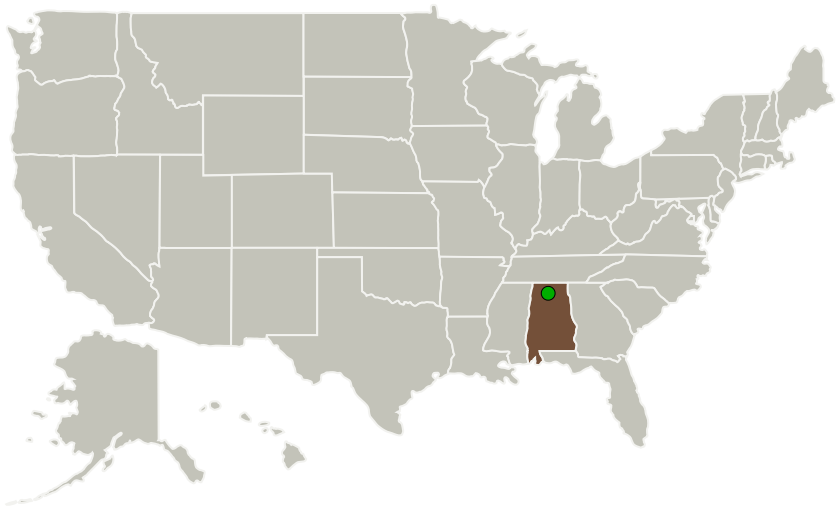
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
ASRC Federal Astronautics, LLC	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

ASRC Federal Astronautics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

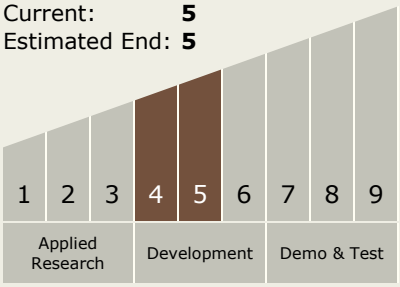
Carlos Torrez

Principal Investigator:

Robert Harrison

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



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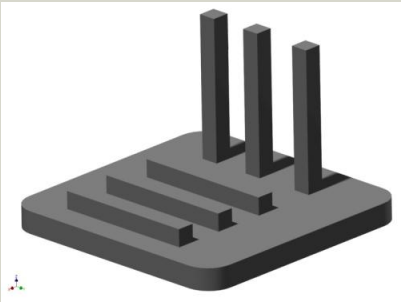
Images



Briefing Chart Image
Additively Manufactured, Thermally Stable Telescope Mirror Substrates, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/132241)*

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System